Is a conservative central banker a (perfect) substitute for wage coordination?*

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Abstract. In a monetary union, macroeconomic policies are strongly associated with externalities that seem to imply the need for macroeconomic policy coordination. However, if coordination is not complete, partial coordination might be unable to cope with the negative externalities arising from a decentralized policy management. This paper investigates different solutions for internalizing policy externalities. In particular, we compare wage coordination to the conservative central banker solution, which is found by recent literature able to impose wage moderation to the labor unions. We also discuss some aspects related to labor flexibility reforms as a solution for the unemployment problem.

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1. Introduction

This paper is about optimal institutions in a monetary union. We refer to three types of institutions: the common central bank, fiscal policy institutions, and trade unions. We consider some alternative ways of devising each of them and analyze the consequences of their interactions. In doing that we attempt to merge some developments in the monetary union literature stimulated by the creation of the European Monetary Union with others in the area of policy games between a central bank and one or more labor unions.

By definition, a monetary union is a highly integrated economic area with a large number of interactions between the participating countries. Given the presence of externalities, the design of macroeconomic coordination is a crucial issue, but coordination is not a trivial outcome.

For instance, one could argue that the introduction of a common monetary policy and restrictions on fiscal policy at the national level increase the need for macroeconomic policy cooperation due to the presence of externalities. However, given the potentially adverse reaction

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of the central bank, fiscal coordination could be counterproductive or ineffective. In other words, the introduction of additional players like an additional country, the central bank or national labor unions could have dramatic effects on the standard propositions based on two-country models, as e.g. Rogoff (1985a) or Kehoe (1988).[1]

The above effect is present in the recent literature. Fiscal authorities subject to a budget constraint are systematically neutralized by the central bank action.[2] This might also be the case for labor union coordination.

In general, the need for international wage coordination emerges from the externalities associated with a nationally decentralized wage bargaining. External effects of wage setting at a national level have the same foundation as those stemming from bargaining at a lower (sub-national) level.[3] In wage setting at a national level perception of the inflationary consequences for a wider than national area is limited and unions tend to be aggressive, as they can beggar-their-neighbor. This is a powerful argument in favor of international wage cooperation. However, as noted above, international cooperation between unions – as distinct from their cooperation at a national level – introduces a new dimension, since unions interact with more common and national policymakers, which also may coordinate their policy or not. This complicates the picture and might lead to different outcomes.

On the other hand, the consideration of trade unions can introduce a new perspective into macroeconomic policy coordination studies. In policy games between a central bank and one or more labor unions the equilibrium real output (gap) is in fact endogenously determined and public authorities may affect it even in a deterministic context.[4] Moreover, the endogenous determination of the real output gap seems to be more relevant for the European context since the European unemployment seems to be related more to structural factors than to cyclical ones (see, e.g., Calmfors, 2001).

The investigation of the role played by a conservative central banker in a monetary union is also of specific interest. The traditional result about the conservative central banker, due to Rogoff (1985b), implies that a conservative central banker eliminates the problem of

[1] In those models, cooperation may be counterproductive since the introduction of a third player may turn the prisoners' dilemma in a deadlock game, where, as in the prisoners' dilemma, the non-cooperative strategy is dominant but a non-cooperative behaviour is better than cooperation. Therefore, no rational player will cooperate.
[2] See, e.g., Acocella and Di Bartolomeo (2001) and Uhlig (2002). On the coordination issue, see also, among the others, Beetsma and Bovenberg (1998), Buti and Sapir (1998), and Beetsma *et al*. (2001) for static analyses and Aarle *et al*. (2002) and (2003) for the problem of macroeconomic policy coordination in a dynamic context.
[3] Seminal studies on the labor union coordination are, among the others, those of Tarantelli (1986) and the Calmfors and Driffill (1988). For some recent contributions see, among the others, Soskice and Iversen (1998), Cukierman and Lippi (1999) and (2002), and Coricelli *et al*. (2000) and (2001).
[4] See Coricelli *et al*. (2000) and (2001), Acocella and Di Bartolomeo (2003), and Cukierman and Lippi (2002).

coordination between wage and monetary setters. Moreover, the recent literature has much debated the effects of a conservative central banker in a closed economy when many monopolistic wage setters operate adding new results to the traditional view.[5] In particular, if many labor unions operate in a monopolistic competition context and they do not take account of inflation, a conservative central banker can always reduce unemployment, in addition to inflation. A conservative banker in fact affects real variables as potential monetary restrictions *reduce* the free-riding behavior associated with the decentralized wage setting.[6] In a monetary union a similar role can be performed by the central banker interacting with national trade unions acting cooperatively.

By linking together different strands of the policy game literature we aim to study some of the indicated problems of coordination in a simple two-country monetary union where a common central bank, national fiscal authorities, and labor unions interact. In particular, we investigate the possibility for a conservative central banker to be a perfect substitute for wage coordination.

2. The model

2.1 The economic framework

Our baseline framework is an IS-AS model adapted to a two-country monetary union where wages are set by national monopoly workers' associations. Therefore, the equilibrium real output gap is endogenously determined and can be different from zero even without considering shock effects.[7] Each country is specialized in the production of one good (or one basket of goods) and goods are imperfect substitutes. There is perfect competition between firms within each country, but imperfect competition between firms operating in different countries. Moreover, the monetary union is assumed to be a closed economy with respect to the rest of the world. In such a context, fiscal policies are determined by national governments and monetary policy by a common central bank. The central bank sets the nominal interest rate, which is common for the whole integrated area since perfect mobility of financial capital is assumed.[8] More in detail, the economic framework where playmakers act is described by two relationships.

[5] See, e.g., Coricelli *et al*. (2000) and (2001), and Cukierman and Lippi (2002).
[6] Notice that Coricelli *et al*. (2000), and subsequent studies, introduce non-neutrality of the monetary policy in a different way from the traditional, which is based on the union inflation aversion (see Gylfason and Lindbeck, 1994). A full discussion on monetary policy non-neutrality in policy games can be found in Acocella and Di Bartolomeo (2003).
[7] The model can be also seen as a two-country static variant of the recent dynamic *New Keynesian* model introduced by McCallum and Nelson (1997). See Uhlig (2002) and footnote 16.
[8] We do not consider the implications of allowing firms to be mobile as between the two countries.

An aggregate demand (*IS curve*) represents the demand side of the economy, whereas the supply side is given by an aggregate firm profit maximization condition.

Domestic demand is decreasing in the domestic expected real interest rate (as an effect of the saving-investment behavior of the private sector) and the product prices differential (competitiveness effects on foreign trade). It increases in home public expenditure, in a Keynesian flavor,[9] and foreign public expenditure (exports). The latter is a shortcut to consider positive fiscal externalities from foreign country taking place through exports. Aggregate demand in the domestic country can then be expressed as:[10]

$$(1) \qquad x_D = -\sigma\left(i - \pi_D^e\right) + \alpha g_D + \beta g_F + \tau\left(p_F - p_D\right)$$

In this equation (1) sub-indexes D and F denote the domestic and the foreign country; $x = y - \overline{y}$ is the real output (employment) gap defined as the difference between the actual level of output y and the potential one, $\overline{y}$, i.e. the competitive-market real output; p is the producer price for the produced composite commodity; g is public expenditure; i is the nominal interest rate, and π_D^e is the domestic expected inflation rate. Thus $i - \pi_D^e$ is the real expected interest rate. Inflation is based on the consumer price index (or CPI), which is a weighted average of domestic and foreign prices:

$$(2) \qquad v_D = (1-h)\, p_D + h p_F$$

As customary, we consider h smaller than $½$. Moreover, perfect foresight and an initial price parametrically set equal to zero are also assumed. Hence $v^e = v$ and $\pi^e = v$ hold. Since we are using a deterministic model, the assumption of perfect foresight is equivalent to that of rational expectations.

The supply side of the economy is described by a standard firm aggregate profit-maximizing condition:

$$(3) \qquad x_D = \rho\left(p_D - w_D\right)$$

which, together with the given nominal wage, w_D, set by the monopoly union, fully describes the aggregate supply in the domestic economy.

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[9] It is assumed that the Ricardian equivalence does not hold, since our fiscal instrument can be seen as a balanced budget (see Acocella and Di Bartolomeo, 2003a: Appendix A) or a cyclically adjusted fiscal deficit (see Beetsma *et al*., 2002; or Uhlig, 2002).

[10] For the sake of the exposition, in describing equations we always refer to the "domestic" country. Of course, similar expressions hold for the "foreign" one. They can be simply obtained by reversing the sub-indices of the variables, because of the symmetry. See Appendix A.

By solving the structural form of the model and assuming, without loss of generality,[11] $\rho = 1$, we obtain the following expression for its reduced form for the domestic country (a similar expression holds for the other country, the foreign country):

$$(4) \qquad \begin{cases} x_D = \xi_0 i + \zeta_1 g_D + \zeta_2 g_F - (1-\xi_1) w_D + \xi_2 w_F \\ v_D = \xi_0 i + \vartheta_1 g_D + \vartheta_2 g_F + \theta_1 w_D + \theta_2 w_F \end{cases}$$

where $\xi_0 = -\sigma/(1-\sigma)$ and $\xi_1 = \dfrac{1+\tau-(1-h)\sigma}{(1-\sigma)(1+\kappa)} > \xi_2 = \dfrac{\tau+h\sigma}{(1-\sigma)(1+\kappa)} > 0$. We assume $\sigma \in (0,1)$ and $\kappa = 2\tau - \sigma(1-2h) > 0$. Appropriately combined, the above parameters ξ_0, ξ_1, and ξ_2, determine the values of all the others as follows: $\xi_1 > \theta_1 = (1-h)\xi_1 + h\xi_2 > \theta_2 = h\xi_1 + (1-h)\xi_2$; $\zeta_1 = \alpha\xi_1 + \beta\xi_2 > \zeta_2 = \alpha\xi_2 + \beta\xi_1$; and $\vartheta_1 = (1-h)\zeta_1 + h\zeta_2 > \vartheta_2 = h\zeta_1 + (1-h)\zeta_2$. The reader should note that the government expenditure of each country has positive (negative) externalities on the employment (price) level of the other country. The assumption $\kappa > 0$ implies that increases in the nominal wage in one country raise real wages (in terms of both CPI and producer prices) and unemployment; reductions in nominal interest rate raise prices and employment, i.e. a *standard trade-off* regime holds. Although this case is the standard textbook situation, other regimes can arise [12]. The consequences of alternative regimes are not trivial (see Acocella and Di Bartolomeo, 2001: Appendix B). However, in this paper we limit our analysis to the *standard trade-off* regime for the sake of brevity.[13]

2.2 Game-timing and policymakers' preferences

We consider a game associated to the following timing. First, unions set wages (in an uncoordinated or coordinated manner), given the domestic labor demands. Then each government sets the public expenditure subject to a budget constraint, and in the end the central bank sets the nominal interest rate. The game timing captures the idea that unions form expectations on the fiscal and monetary policy, and that fiscal policy is "less flexible" than the monetary policy (i.e., in setting their instruments fiscal policymakers form rational expectations

[11] See Acocella and Di Bartolomeo (2001).
[12] See Beetsma *et al*. (2002) for a discussion on the importance of the different kinds of externality for the policy coordination in a monetary union.
[13] Note that although the situation considered is the standard textbook one, more regimes can arise (for instance, if real income spillovers are absent, κ is negative).

on the monetary authority's actions). Prices are flexible and can continuously adjust at no cost.[14] The game is solved backwards until the sub game perfect equilibrium is found.

The preferences of the central bank are defined over the monetary union aggregates:

$$(5) \qquad V = -\frac{b}{2}\left(\sum_{j\in N} v_j\right)^2 - \frac{1}{2}\left(\sum_{j\in N} x_j\right)^2$$

where b is the degree of conservativeness of the central bank and $N = \{D, F\}$ is the set of the countries.

Each government seeks to minimize a similar loss function based on domestic variables:

$$(6) \qquad G_j = -\frac{t_j}{2} v_j^{\,2} - \frac{1}{2} x_j^{\,2} \qquad\qquad j \in N$$

Moreover, governments must respect a constraint on their instruments: $g_j \le \overline{g}_j$ for $j \in N$. This limitation is imposed in order to capture the *Stability and Growth Pact*, which characterizes the European Monetary Union. Another way used by the literature to model the *Stability and Growth Pact* is to directly insert an instrument cost into the governments' losses.[15] In our context, the additional-constraint approach seems to be a better way to model the *Stability and Growth Pact*. However, we have checked that our results do not depend on the way according to which the budget constraint is modeled, as they are also robust to the instrument-cost approach.

Each union maximizes the following standard preference function:

$$(7) \qquad U_j = q_j\left(w_j - v_j\right) - \frac{1}{2} x_j^2 \qquad\qquad j \in N$$

In the above equation q_j can be interpreted as the degree of distortion in the labor market, which depends on the strength of the national unions and the national unemployment benefit structure and employment protection legislation.[16]

2.3 The decentralized equilibrium

In this sub-section, we consider the solution when the two unions simultaneously set the national nominal wage in a non-cooperative manner. The game is solved by backward induction according to the timing explained in the previous sub-section.

[14] For a more extensive discussion on policy game timing and rational expectations, see Ljungqvist and Sargent (2000: Chapter 16).
[15] See, among the others, Aarle *et al*. (2002) and (2003), Beetsma *et al*. (2002), and Uhlig (2002).
[16] Changes in q_j could also play the role of supply-side shocks, as in Uhlig (2002). In such a case we should talk about cyclical rather than structural unemployment.

The optimization problem of the central bank consists in minimizing equation (5) with respect to the nominal interest rate, taking account of the constraint (4). The reaction function of the central bank is then given by the following expression:

$$(8) \qquad i = \frac{1}{2}\left[(\alpha+\beta)\sum_{j\in N}\frac{g_j}{\sigma} + \frac{\sigma+b}{1+b}\sum_{j\in N}\frac{w_j}{\sigma}\right]$$

Once the monetary policy rule is obtained, by maximizing equation (6) under the constraint (4) and (8), we find the domestic government reaction function (a similar expression holds for the foreign government):

$$(9) \qquad g_D = g_F + \frac{(2\kappa t_D - \upsilon_D)b + \kappa t_D - (1-2h)\left[2(1-h)+\kappa\right]}{(\alpha-\beta)(1+b)\upsilon_D} w_D + \frac{\upsilon_D b - \kappa t_D - (1-2h)(2h+\kappa)}{(\alpha-\beta)(1+b)\upsilon_D} w_F$$

where $\upsilon_D = 1 + t_D - 4h(1-h)$. Equation (9) implies that each government reacts to the other by raising the public expenditure. Moreover, the ceilings imposed to fiscal expenditures are always binding, since the reaction functions of the two governments are parallel. Thus, $g_D = \bar{g}_D$ and $g_F = \bar{g}_F$ always hold.[17]

Each union maximizes its preference function subject to the optimal monetary (equation (8)) and fiscal policy (equation (9)) rules. The domestic union reaction function turns out to be:

$$(10) \qquad w_D = \frac{(\kappa-b)}{(1+2\kappa)b+\kappa} w_F + \frac{(\alpha-\beta)(1+b)}{(1+2\kappa)b+\kappa}(\bar{g}_D - \bar{g}_F) + \frac{2(1+\kappa)(1+b)\left[(1+2\kappa)b+2h+\kappa\right]}{\left[(1+2\kappa)b+\kappa\right]^2} q_D$$

Notice that, if $b > \kappa$, the domestic union reaction to increases in foreign nominal wages implies a restrictive wage policy because of the potential adverse reaction of the monetary policy, the more so the higher b is.

By solving the two-equation system formed by equation (10) and its foreign country analogue, we obtain the following economic equilibrium outcomes:

$$(11) \qquad x_D = -\left(1 + \frac{2h(1+b)}{(1+2\kappa)b+\kappa}\right) q_D$$

$$(12) \qquad v_D = \left(1 + \frac{2(\kappa+hb)}{(1+2\kappa)b+\kappa}\right)\frac{q_D}{2} + \frac{(1+2h+2\kappa)b+\kappa}{(1+2\kappa)b+\kappa}\frac{h}{\kappa}\frac{q_D - q_F}{2} + \frac{(\alpha-\beta)(1-2h)}{\kappa}\frac{\bar{g}_D - \bar{g}_F}{2}$$

Similar expressions hold for the foreign country.

Average real output and inflation in the monetary union are:

[17] In other words, the imposition of a fiscal constraint solves the fiscal coordination problem and rules out the possible non-existence of a solution. For a full discussion, see Andersen and Schneider (1985).

(13) $$\frac{1}{2}\sum_{j\in N} x_j = \frac{(1+2h+2\kappa)b+2h+\kappa}{(1+2\kappa)b+\kappa}\frac{1}{2}\sum_{j\in N} q_j = -\left(1+\frac{2h(1+b)}{(1+2\kappa)b+\kappa}\right)\frac{1}{2}\sum_{j\in N} q_j$$

(14) $$\frac{1}{2}\sum_{j\in N} v_j = \frac{1}{b}\left(\frac{(1+2h+2\kappa)b+2h+\kappa}{(1+2\kappa)b+\kappa}\right)\frac{1}{2}\sum_{j\in N} q_j = \frac{1}{b}\left(1+\frac{2h(b+1)}{(1+2\kappa)b+\kappa}\right)\frac{1}{2}\sum_{j\in N} q_j$$

Equation (11) and (13) imply that monetary policy affects domestic and average real output. The result is not surprising since the existence of a wedge between the real wage relevant for firms (based on producer prices) and the real wage relevant for the unions (based on the consumer price index).[18]

It is easy to check that the real output gap is increasing in the elasticity of the terms of trade (τ) and decreasing in the foreign price weight in the consumer price index (h). This result is worth commenting in the light of the hump-shaped hypothesis suggested by Calmfors and Driffill (1988). In their analysis there are two opposing forces (competition and consideration of effects of wage changes on the CPI) which determine the outcome of decentralized wage bargaining. The same two forces operate in a more explicit way in our model at an international level.

By derivation of equation (13) and (14) with respect to b, we can also assert that increases in the central bank degree of conservativeness reduce the inflation rate and raise the real output level (or reduce the real output gap). Hence, the same result as in Coricelli *et al*. (2000) holds in our model.

Since the conservative central banker increases the social welfare (in terms of any welfare function decreasing in inflation and unemployment), it is interesting to compute the ultra conservative central bank solution, i.e. the solution associated with $b \to +\infty$. This turns out to be:

(15) $$\frac{1}{2}\sum_{j\in N} x_j = -\frac{1+2(h+\kappa)}{1+2\kappa}\frac{1}{2}\sum_{j\in N} q_j$$

(16) $$\frac{1}{2}\sum_{j\in N} v_j = 0$$

Note that the output gap associated to equation (15) is the lowest possible in a monetary union with decentralized labor markets since the real output gap monotonically decreases with the degree of conservativeness.

Budget constraints rule fiscal authorities out of the demand policy setting. In fact, these can affect neither domestic real output nor average output and inflation in the monetary union.

[18] See Acocella and Di Bartolomeo (2003).

The central bank supremacy implied by the budget constraints confirms some intuitions highlighted, in a different context, by Calmfors (2001) about the effects of a monetary union on the need for flexibility.[19] Increases in the degree of conservativeness of the central bank can in fact reduce the incentive for labor market reforms, i.e. reduction in labor market distortion (q_i), since in solving the inflation bias problem a more conservative central bank also reduces unemployment.[20]

Fiscal policy does not affect the domestic price either, if the budget constraints of the two countries are equal. It can only affect the distribution of inflation between the countries. Therefore, the *Stability and Growth Pact* can be used to equalize the different inflation rate among the countries associated with different labor market distortions.

Assuming that a uniform inflation rate in the monetary union is a desired target for the common institutions, it could be reached irrespectively of the different labor market distortions by imposing the following relative budget constraint:[21]

$$(17) \qquad \bar{g}_D = \bar{g}_F - \frac{\left[(1+2h+2\kappa)b+\kappa\right]}{(\alpha-\beta)\left[(1+2\kappa)b+\kappa\right]}(q_D - q_F) = \bar{g}_F - \frac{1}{\alpha-\beta}\left(1+\frac{2hb}{(1+2\kappa)b+\kappa}\right)(q_D - q_F)$$

Of course, equation (17) implies an equal ceiling to government expenditure in the two countries if the union is symmetric, i.e. both the domestic and the foreign country are associated with an equal degree of distortion in the labor market.[22] In the asymmetric case, countries with higher distortions should be associated with a more stringent constraint, and vice versa.

2.4 The centralized equilibrium

In this sub-section, we consider the solutions of a game when the two unions seek to maximize the following common preference function instead of equation (7):

$$(18) \qquad U = \frac{1}{2}\sum_{j\in N}\left[q_j\left(w_j - v_j\right) - \frac{1}{2}x_j^2\right] \qquad\qquad j \in N$$

By solving in a similar manner to that of the previous sub-section, we obtain the following equilibrium outcomes for the domestic country and the monetary union area:

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[19] Calmfors (2001) compares the position of countries inside a monetary union to those outside it with respect to the desirability of labor market reforms.

[20] Of course, the underlying assumption is that the central bank is more conservative than the government.

[21] Recall that in our symmetric framework the common central bank cannot affect national prices and output gaps in a differentiated manner.

[22] In this paper we focus on asymmetries in the labor markets only. Without them an equal budget constraint would be required. The policy of differentiating the budget constraints can be applied also in the case of asymmetries implied by different factors. However, the case of asymmetries in the union preferences is the most interesting one, since union action in the model is endogenous, and therefore, it might neutralize any attempt to equalize national inflation rates.

(19) $$x_D = -\left(1+\frac{h}{\kappa}\right)q_D + \frac{h}{\kappa}q_F = -q_D + \frac{h}{\kappa}(q_F - q_D)$$

(20) $$v_D = \frac{1}{b}\left[\frac{q_D + q_F}{2} + \frac{(1+2h)(2h+\kappa)}{\kappa^2}\frac{q_D - q_F}{2}\right] + \frac{(\alpha-\beta)(1-2h)}{\kappa}\frac{\overline{g}_D - \overline{g}_F}{2}$$

(21) $$\frac{1}{2}\sum_{j\in N} x_j = -\frac{1}{2}\sum_{j\in N} q_i$$

(22) $$\frac{1}{2}\sum_{j\in N} v_j = \frac{1}{b}\left(\frac{1}{2}\sum_{j\in N} q_j\right)$$

Now unions internalize the negative externality associated with the decentralized bargaining and the central bank cannot affect the real output either domestically or in the average of the monetary union.[23] The degree of conservatism of the central bank is then irrelevant. Fiscal policy again cannot affect aggregate variables and can be used only to equalize inflation rates in the area by introducing an appropriate relative budget constraint. An ultra conservative central bank reduces the inflation to zero, i.e. the standard conservative central banker's result applies.

The centralized labor market solution is always associated with a lower real output gap than the decentralized one, as we can derive by comparing equation (21) with equation (15). Recall that equation (15) is the lowest real output gap associated with the decentralized solution. In addition, by comparing equation (22) with equation (14), it is found that the centralized labor market solution is also associated with a lower inflation average.

In both equation (11) and (19) real output can be increased by reducing the labor market distortion parameters. For instance, a reform reducing unemployment benefits reduces q_i, as it increases the costs of unemployment and, therefore, the marginal rate of substitution between output (employment) and the real wage. This result would highlight the need for flexibility in European countries as unemployment solution suggested by, among the others, OECD (1994), Bean (1998) and subsequent literature. However, in a way similar to that used by Soskice (1990) in analyzing the hump-shaped hypothesis in a closed economy, we show that this is not the only way since a different policy can lead to similar results by increasing the wage setter coordination at the European level.

3. Summary and conclusions

If, in order to solve the problem of coordination between the central bank and national governments, national budget ceilings are imposed, monetary policy dominates over fiscal

policy, which has limited effects on the economy. The cost of this crowding-out is given by the relative rigidity of the monetary policy, which cannot differentially react to asymmetries present, e.g., in the labor markets. A limited solution to this problem is to manage the relative budget constraint, i.e. the budget constraint of one country relatively to the other. Fiscal policy can only be used to redistribute the effects of inflation, as it is unable to affect real output at both the national and the monetary union level.

A conservative central bank solves the problem of coordination between the monetary authority and wage setters. It eliminates the central bank's temptation to inflate the economy in the attempt to reduce the real output gap and, therefore, eliminates the inflation bias. Moreover, if wages are set in a decentralized manner, the central bank also has an influence on the real output gap. This is due to the lack of coordination between the national labor unions, which are unable to internalize the negative externalities associated with decentralized wage bargaining. A more conservative central bank induces wage moderation since the unions understand that their attempt to export inflation when they raise nominal wages will be impaired by the central bank.

A conservative central bank is however only a second best solution in internalizing the externalities arising from decentralized wage bargaining, as wage coordination is Pareto superior to the decentralized solution for any possible value of the degree of conservativeness. In other words, the imposition of a conservative central banker only partially solves the problem of coordination between the two national labor unions. However, as said before, it eliminates the problem of coordination between labor unions and the central bank.

Summarizing, the imposition of budget ceilings to fiscal policy public expenditure can solve the coordination problem between the governments and the central bank and between fiscal authorities. However, this solution is not without costs. As to the conservativeness of the central bank the central banker solution remains a first best solution for solving the negative externality associated with the decentralization of supply (nominal wage) and demand (nominal supply of money) policies. In the case of decentralization of wage bargaining, it also has the favorable property that it increases the real output by imposing wage moderation. However, the roots of monetary policy effects on real output are different from the traditional ones[24] and monetary policy results to be only a second best policy for internalizing the decentralized wage-setting externalities.

[23] Note that average outcomes are independent of the economy parameters. This is due to the symmetry of the structure of the two countries and to the fact that unions internalize the externalities.
[24] See Gylfason and Lindbeck (1994).

The results of our paper seem to confirm that recent policy of European labor unions attempting to increase wage coordination goes in the right direction and should be given an incentive by the European Institutions.

Appendix A – The reduced form model

The reduced form model can be expressed in matrix terms as follows:

$$\text{(A.1)} \quad \begin{bmatrix} x_D \\ x_F \\ v_D \\ v_F \end{bmatrix} = \begin{bmatrix} \xi_0 \\ \xi_0 \\ \xi_0 \\ \xi_0 \end{bmatrix} r + \begin{bmatrix} \zeta_1 & \zeta_2 & -(1-\xi_1) & \xi_2 \\ \zeta_2 & \zeta_1 & \xi_2 & -(1-\xi_1) \\ \vartheta_1 & \vartheta_2 & \theta_1 & \theta_2 \\ \vartheta_2 & \vartheta_1 & \theta_2 & \theta_1 \end{bmatrix} \begin{bmatrix} g_D \\ g_F \\ w_D \\ w_F \end{bmatrix}$$

Equation (A.1) describes a symmetric monetary union. In fact, this paper focuses on asymmetries associated with the players' preferences only. More details on the structural and reduced form of the model, its derivation, and the possible regimes, which can emerge, can be found in the appendices of our longer working paper version of this article (i.e. Acocella and Di Bartolomeo, 2001).

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